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The Editors

TRENDS IN THE EVOLUTION OF TELEOSTEAN FISHES[1]

By George S. Myers

The teleosts or modern-type bony fishes provide wonderful material for phylogenetic investigation. Their living species are far more numerous than all other Recent vertebrates combined, and this ratio probably has existed throughout the Cenozoic. If the number of species or of individuals is taken as a criterion of evolutionary success, then the teleosts are the most successful of all chordates.

It is true that study of fossil teleosts has languished, and we do not have anything like the amount of paleontological evidence available to students of mammalian evolution. On the other hand, there are large accumulations of fossil teleosts awaiting study in the museums of the world, if students can be found to work on them. Perhaps even more important, the seas and rivers of the world harbor a museum of still existing generalized or annectent relicts unequalled in any other class of vertebrates. Many Eocene genera, or their very close relatives, belonging to a number of different orders, are still alive, a statement that cannot be made for mammals, birds, reptiles or perhaps even the amphibians. Many of them are perhaps bradytelic lines representing fairly well the ancestral stocks. In many ways, this makes up for the paucity of research on fossils. As a matter of fact, some of the few fish paleontologists have already recognized that much work in their field has been badly handicapped by lack of the equally or more important phylogenetic information derivable from the examination of the plethora of living teleosts.

However, phylogenetic studies of the bony fishes have been plagued by the very richness of the group. On one hand, many systematists have had their hands full with work on the fishes of one area and have often known little of any one systematic group beyond that area. Conversely, morphologists, who usually know the systematic groups even less well, have sometimes based conclusions upon a few species or genera chosen more or less at random, whilst unaware that a better knowledge of the group concerned might show these examples to be atypical or specialized, and misleading so far as the general phylogenetic picture is concerned.

Examination or consideration of all known species (or at least genera) of a group, combined with anatomical work done on examples intelligently selected for their apparent phylogenetic importance (rather than their mere availability) is likely to provide more dependable results. Indeed, research of this type proves that the old adage, "Analysis must precede synthesis", is as true today as it ever was, and that some recent attempts on the part of paleontologists and morphologists to draw broad conclusions on teleostean evolution without extensive knowledge of the groups concerned, were, to say the least, premature.

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[1] Given before the Society for the Study of Evolution at the Stanford meeting, August, 1957.

Not a great deal can be said of teleostean evolution in ten or fifteen minutes but I wish to present a few evolutionary trends observable in two groups that I have studied for many years, and which point to conclusions at variance with those of previous workers. I hope also to shed a little additional light on some trends already recognized.

The small fishes of the family Cyprinodontidae include not only *Fundulus*, well known as an experimental animal at Woods Hole, but also a host of other genera and species scattered through the world, principally the fresh waters of the tropics. Hitherto, the only candidate for the distinction of being the most generalized cyprinodont is *Profundulus*, a close ally of *Fundulus*. However, study of practically every known genus of the family leads me to the conclusion that, instead, the Oriental genus *Aplocheilus* presents by far the largest number of basic characters that have become specialized or even lost in other members of the family.

The distribution of the entire subfamily to which *Aplocheilus* belongs is a southerly one, principally African and South American. In this it resembles the southern peripheral distribution of the more primitive members of many groups of terrestrial and fresh-water vertebrates and invertebrates. *Aplocheilus* itself has a distribution (in Southern Asia) peripheral to its closest relatives in Africa. Evidently it has not inhabited India and Malaya very long.

The trends from the generalized characters of *Aplocheilus* to more specialized ones are:

1. The maxillary bone, lying free, exposed, and movable on the side of the head in *Aplocheilus* (as in all generalized teleosts) has become partly embedded in the flesh of the preorbital region in the African genus *Epiplatys*, and is completely embedded and practically immovable in all other members of the subfamily and family.

2. The band of several irregular rows of sharp conical teeth, present in full array in *Aplocheilus*, is found also in many other members of the family but in several genera these teeth have been reduced to two weak rows (as in *Chriopeops*), or to one (as in a few African and American genera). In other lines the conical teeth have become bicuspid or tricuspid. The ultimate is reached in the highly specialized East African *Pantanodon*, which has lost all the jaw teeth.

3. The prevomer is present in *Aplocheilus* and bears teeth. These teeth are present in most of the close allies of *Aplocheilus* (the subfamily Rivulinae) but have become lost in all other subfamilies. If preliminary results can be believed, the genus *Oryzias*, which may represent a different subfamily or even family, has lost even the prevomer itself.

4. The pseudobranchiae, poorly developed at best in the cyprinodonts, are present in *Aplocheilus* and other members of its subfamily, but have disappeared in most or all of the other groups of the family.

5. The pectoral fins, which are set low on the sides of all the more primitive teleosts and ganoids, are also in a relatively low position in *Aplocheilus*. Trends towards high-set pectorals are observable in the peculiar genus *Oryzias*, and in the African *Aplocheilichthys* group, culminating in the very high pectorals of the specialized African genera *Procatopus*, *Lamprichthys*, and *Pantanodon* and in the minute Amazonian genus *Potamophylax*.

6. The general body form of *Aplocheilus* fairly well represents the norm for the family, which, in different specialized lines, shows deepening and compression of the body as in *Cyprinodon*, *Adinia*, *Procatopus*, and *Lamprichthys*.

7. The breeding behavior and life cycle of *Aplocheilus* represent the norm for the tropical members of the family. It is a perennial fish, living for three or four years. Within its own subfamily, several other genera in Africa and South America have become annuals, adapted to life in

isolated pools which dry up in the dry season, the population existing for a time solely as fertilized eggs buried in the damp mud under the top-crust.

It will be noted that trends towards loss or simplification (in the jaw teeth and vomerine teeth, and in the pseudobranchiae) bulk large in the picture of cyprinodont evolution. The same is true of the much larger fresh-water family Characidae. In this group, the exact pattern of the teeth forms a character of great importance. It would normally be presumed that a simple pattern of conical teeth would indicate generalization, but among the living characids, the genera undoubtedly most generalized in the sum total of their characters (*Brycon* in South America, *Alestes* in Africa) possess two or three rows of strong, very highly sculptured premaxillary teeth. In at least one genus *(Creagrudite)* the transition from three to two rows and from cusped to nearly conical teeth can be traced ontogenetically. In other highly specialized forms *(Bramocharax, Phoxinopsis)* what appear to be conical teeth can be seen to show the remnants of cusps. Finally, in the toothless genus *Curimata*, the postlarvae possess teeth, as would be expected.

A contrary view of tooth evolution in some characids has been expressed by Gregory and Conrad (1938), who select the minute fishes of the genus *Cheirodon*, with their weak, one-rowed teeth, as representative of the most generalized stock. I would consider that the one-rowed teeth of this genus indicate specialization. This view is reinforced by consideration of size trends in the teleosts, a subject that has not received much attention.

Among the 33,000 or more living species of teleosts, the average adult length is, I believe, between four and five inches. Individual families differ greatly in average length, and size ranges is often roughly correlated with the number of included genera and species. Thus a few very extensive families, such as the sea-basses, cyprinids and characids, include both minute species, adult at one to three inches in length, and giant forms attaining a length of four, five, or six feet. Most fish families, and even many orders, have no such length-range, even the excessively numerous gobies being almost all very small to minute fishes.

A number of teleostean families run to minute size and it is observable that the smallest forms are, in this feature at least, specialized. The minute species of which I speak are usually from 10 to 25 millimeters long when fully adult. Minute fishes of many families and orders often exhibit similar specialized morphological trends correlated with small size. Among these are:

1. Reduction in the number of scales towards or beyond the minimum exhibited by larger species of the same group.
2. A similar but less striking reduction in the number of fin rays.
3. A reduction or simplification of the dentition.
4. Reduction or suppression of the lateral line on the body.
5. A reduction or simplification of cranial sculpture and of the supra-occipital crest.
6. A minimal development of fin extensions seen in larger members of the group concerned.
7. In some forms, at least, the retention of the pronephros as a functional kidney.

That the last three are indicative of neoteny or arrested development is obvious. Almost all these minute fishes seem to feed principally on small crustaceans.

The small characids of the genus *Cheirodon* are adult at 25 to 30 millimeters and exhibit nearly all the specializations listed. They are cer-

tainly not the generalized bradytelic survivors of the main characid stem, as Gregory and Conrad have assumed.

I wish finally to discuss one general trend that has been dealt with only by Gregory. In the earliest of the teleostome or actinopterygian fishes (the Paleozoic palaeoniscids), one of the principal features of the appearance of these fishes lies in the strong posterior direction of the jaw suspensorium, principally the hyomandibular. The eye is very far forward, the snout extends forward beyond the mouth, and the large mouth extends far backward.

One of the features of bony fish evolution is the swinging forward of the jaw suspension to a vertical or forward-directed position, concomitant with a reduction in the size of the mouth. (The direction of the suspension is usually but not always indicated exteriorly by the position of the posterior edge of the preopercle.) It has been assumed by Gregory and others that the teleosts arose from primitive teleostomes in which the forward swing had been accomplished, and that the modern teleosts which possess a backward-directed suspensorium have re-evolved a jaw pattern superficially similar to that of the palaeoniscids.

A recent survey of the actinopterygian jaw suspension, however, brings to light some interesting facts. The *first* is that those ganoid fishes known as chondrosteans (the paddlefishes and sturgeons) apparently never made the forward swing, even though, in the sturgeons, the mouth has become very small. *Second*, in the great mass of teleosts, the vertical or forward swing of the jaw suspension seems to have been a trend difficult to reverse, for a well-developed backward swing has, outside certain orders, been attained only in a very few instances (the females of a few genera of ceratioids, the chiasmodonts, and a few berycoids and opisthognathids). The development of a large mouth in the teleosts has almost invariably been accomplished instead by lengthening the jaws, or broadening or deepening the head, or both. *Third*, almost all teleosts which do exhibit a well-developed backward swing are concentrated in a few orders known to be very old and generalized, and among them the backward swing is not always correlated with a large mouth. *Chanos*, the milkfish, is an example. Almost all these fishes are included in the Apodes, or true eels, and in the heterogeneous and probably unnatural orders Isospondyli and Iniomi, which consist of numerous phyletic lines of unknown but undoubtedly rather primitive ancestry.

These facts, added to the modern view that the holosteans may be of diverse ancestry among the early teleostomes, permit one to believe that a backward-swung jaw suspension in some of these primitive teleosts is at least conceivably a surviving relict of still unknown teleostome ancestors with a paleoniscid-like suspensorium.

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NOMENCLATOR OF CERTAIN TERMS USED FOR HIGHER CATEGORIES OF FISHES

By George S. Myers

This list forms the beginning of an attempt to trace the usage of the better known terms applied to the higher groups of fishes, especially orders. It was compiled in 1950 for the use of the Committee on Fish Classification of the American Society of Ichthyologists and Herpetologists, of which the writer was then chairman. The names included pertain more especially to the cartilaginous and lower bony fishes. The list is very incomplete but compilation had to be laid aside and time has not been found up to the present to continue the work. However, it is felt that publication of what has been done may be of some use to ichthyologists.

There is often difficulty in determining what concepts were intended by the proposers or users of some of the terms listed, especially before 1860. It must be remembered that our present hierarchy of superior categories did not become well established until the latter part of the 19th Century. Although the familial and ordinal concepts were well understood in the Cuvierian school (see especially Latreille, 1825, Familles naturelles du Règne Animal), the usage of the uniform -idae ending for familial names seems to have been first established in 1829 by Prince Lucien Bonaparte (Saggio, etc.) and was not generally adopted until incorporated into the Stricklandian Code of the British Association in 1842.

As an example of the type of error that has been made, we may take the term Cyprinodontes, resurrected by Jordan in 1923 as an ordinal term to replace Microcyprini of Regan. Jordan seems to have believed that Agassiz used Cyprinodontes as a term superior to that of a family, whereas perusal of Agassiz's early work shows clearly that he intended the term purely in a familial sense. Regan (1909) was the first to suggest that the cyprinodonts represent a group of ordinal rank, and if we are not to accept some system of uniform endings for ordinal terms (a system to which I strongly object) there is no reason whatsoever to supplant Regan's widely used name Microcyprini.

The writer feels little sympathy with a sometimes vociferous group of American ichthyologists, often unfamiliar with fish classification beyond their own regions or above the family level, or both, and usually totally unaware of the needs and desires of zoologists working on other animal groups, who nevertheless presume to pass judgement on the means by which superior group names in the animal kingdom should be formed, selected and used. The higher classification of fishes has been built up through anatomical work by a long series of able and thoughtful men, such as Artedi, Cuvier, Müller, Günther, Gill, Cope, Boulenger, and Regan. Through the work of all of these men there is much continuity, not only in concepts but in the nomenclature of the higher groups, culminating in Regan's excellent classification of 1929 (Encycl. Brittanica, article on fishes). Berg's classification of 1939 was, so far as Recent fishes are concerned, mostly an acceptance or slight reshuffling of the Regan classification, but, in imitation of Goodrich (1909, in Lankester's Treatise) and the Wetmore and Miller system for birds, Berg adopted the -iformes ending for ordinal

names. Such a strong break with precedent and familiar terminology appears to have had a bad effect on those American fish specialists who deal little with superior group classification and who demand a text-book classification for general use. And it resulted in an ill-advised stampede towards uniform endings of suprafamilial group names in fishes. One group adopted the Berg system, often simply because it was available in book form. Some became followers of the "Stenzel system" (which is at least comprehensive and coherent), and still others the fundamentally different and curiously anarchic Schultz and Stern system.

The situation has not been helped by certain well-known paleontological reviewers who, lacking familiarity with more than some selected "representtative types" of Recent bony fishes, and being unable or unwilling to comprehend the size and complexity of the group, have summarily lumped whole series of phyletically diverse orders into such preposterous groupings as the "Order Mesichthyes." Yet these same writers see nothing incongruous in accepting over thirty orders of a morphologically restricted offshoot of the archosaurs, the birds—a group even today not one third as numerous as the teleostean fishes!

The result of the above trends has been anarchy in the terminology of superior fish groups, but few American ichthyologists seem to realize that the fault is their own. Even some of the most eminent ornithologists have already dropped the -iformes endings of ordinal names for birds (see Mayr and Amadon, 1951, A classification of Recent birds, Amer. Mus. Novit., no. 1496). Zoologists as a whole seem unwilling to cast out such universally understood terms as Coleoptera, Amphipoda, Isopoda, Foraminifera, Carnivora, Primates, Tubinares, and Heterosomata, in favor of some system of type genera and uniform endings, which would wipe out all of the best-known ordinal names in zoology. It seems unlikely that the International Rules of Zoological Nomenclature, when they are expanded to cover names above the family level, will be permitted to create such havoc.

Fishes outnumber all other living vertebrates almost two to one. Their major classification is not as well understood as that of mammals and birds. Rather important changes in major classification are thus to be expected. In part, the cry for uniformity in superior group names of fishes stems from the confusion of this inescapable zoological problem with that of mere nomenclature. No nomenclatural system can avoid instability caused by progress in understanding relationships. And ichthyologists are bound to be troubled more in this way than specialists in many other animal groups.

Convinced that no system of uniform endings will ever prevail in zoology, the writer believes that ichthyologists would do well to recognize that stability (albeit a shaky stability) would be best served by preserving continuity with past usage in the superior group names of fishes. The situation in fishes is not unlike that in mammals (although more complex) and rules for superior group names have been formulated by Simpson (1945, The principles of classification and a classification of mammals, Bull. Amer. Mus. Nat. Hist., vol. 85) and applied by him with success to mammal names. The present writer subscribes heartily to Simpson's ideas and rules, and his remarks on the acceptance or rejection of many names are based on those rules. The following nomenclator will be of use if there is any serious attempt to stabilize fish names by Simpson's system.

The references given are brief and unorthodox, but most of them may be located in Dean's Bibliography of Fishes.

ACANTHORRHINI Bonaparte 1832 (Saggio, II, p. 63). See under Holocephala.

ACTINISTIA Cope 1871 (Ichthyol. Lesser Antilles, p. 451). Order. Proposed solely for Coelacanthidae. An exact synonym of Coelacanthini Huxley 1861, but the latter was proposed as a family only.

ACTINOPTERI Cope 1871 (Ichthyol. Lesser Antilles, p. 449). Subclass. To include ganoids and teleosts, but excluding lungfishes and Polypterus. Practically equivalent to Teleostomi of Bonaparte as emended by Owen in 1866. Cope later emended the name to Actinopterygia. E. F. Klein (1885), Traquair (1900), and Goodrich (1909) used the form Actinopterygii, but the original form, used by Cope and by Hay (1902; 1929) is perfectly good. Probably should be replaced by the older and more widely used Teleostomi.

ACTINOPTERYGII. See Actinopteri.

AGNATHA (?Cope 1891) Woodward 1891 (Cat. fossil fishes, vol. 2, p. xvii). (Cope not yet checked.) Used first by Woodward, among works I have seen, in a recognizable sense for the agnathous living forms.

AGNATHOSTOMATA (Bridge 1904, Cambridge Nat. Hist., vol. 7, pp. 145-147). This is the group also called Agnatha. Agnathostomata has been little used and should perhaps fall in favor of the now widely used Agnatha. The idea of splitting the vertebrates into two main divisions on jaw structure perhaps originated with the Cambridge group of zoologists (Harmley, Bridge, Gadow, Shipley, MacBride).

AMPHIBIOIDEI Hubbs 1919 (Science, n.s., vol. 49, p. 570). Subclass. To include lungfishes and crossopterygians. Equivalent to the later Choanichthyes of Romer, which see.

AMIOIDEI Eastman 1909; Regan 1911. Equivalent to Halecomorphi Cope 1871, which see. Rejected for ordinal use because of its subordinal or superfamilial ending and because it is a synonym of an older, more widely used name.

ANASPIDA Traquair 1898 (Trans. R. Soc. Edinburgh). (Not checked). For Lasanius and its allies.

APHETOHYOIDEA D.M.S. Watson 1937 (Acanthodian fishes). Class. Practically equivalent to Placodermi McCoy 1848, which see.

APODES (Artedi) Linnaeus 1758 (Syst. nat., ed. 10, tom. 1, p. 241). Order. Proposed for all fishes lacking pelvic fins. Gradually restricted to the true eels by many writers. Not to be confused with Apoda, used in such diverse groups as amphibians and crustaceans.

ARCHISTIA Regan 1929 (Encycl. Brit., Ed. 14, art. on fishes). Order. Equivalent to Lysopteri Cope 1880 and no better known or more widely used. Palaeoniscoidei has been the name most frequently used of late but it cannot be used for an order because the ending conflicts with the uniform one for a grade below order.

BELONORHYNCHII Regan 1929 (Encycl. Brit., Ed. 14, art. on fishes). Order. To include Saurichthyidae (Belonorhynchidae). Identical with the suborder Saurichthyoidei Goodrich 1930 (Struct. devel. vert., p. xvii).

BRACHIOPTERYGII Stensiö 1932. (Not checked. Evidently equals Cladistia Cope 1871.)

CEPHALASPIDOMORPHI Goodrich 1909 (Lankester's Treatise, pp. ix, 200). Order. For Ateleaspidae, Cephalaspidae, and Trematapidae. Apparently a synonym of Osteostraci, of Ostracodermi, and of Ostracophori.

CHISMOPNEA (Duméril 1806, Zool. anal., pp. 97, 105) Rafinesque 1815 (Analyse de la nature.) Order. Duméril included Batrachus, Balistes, Lophius, and Chimaera; he used the vernacular French name "Chismopnes". Rafinesque latinized the name and added some eels. Bonaparte 1832 (Saggio II, p. 63) modified the name to Chismopnei and restricted it to chimaeroids and sturgeons. Garman 1904 (Bull. M.C.Z., vol. 41, p. 270) applied Rafinesque's term to chimaeroids alone. Regan (1906, P.Z.S., p. 724) modified it to Chasmatopnea and used it as a "series" (that is, superorder) to include the single order Holocephali. Aside from these four authors, the name has had little currency.

CHOANICHTHYES Romer 1937 (Bull. M.C.Z., vol. 82, no. 1, p. 56). Class.

For Crossopteri plus lungfishes. Exactly equivalent to Amphibioidei Hubbs 1919, which see. It is an open question whether we shall accept Amphibioidei, which has been used by few save Hubbs, or Choanichthyes, which has gained rather wide acceptance through use by Parker and Haswell (Forster-Cooper, editor) and in Romer's Vertebrate Paleontology.

CHONDRICHTHYES Goodrich 1909 (Lankester's Treatise, p. viii). Proposed as a "subgrade", between a class and a subclass, to include Elasmobranchii, Pleuracanthodii, Cladoselachii and Acanthodii. Equivalent in general to Chondropterygii of Artedi 1738 as emended by Günther 1870, and to Plagiostomi Meckel 1809, etc. Chondropterygii needs no more emendation from its original sense than does this superfluous term.

CHONDROBRACHII (Author not yet found). Cited by Berg 1941 as equivalent to his Ateleopiformes.

CHONDROPTERYGII (Artedi) Gronow 1763 (or J. F. Gmelin 1788). Order. Used by Linnaeus 1735, (probably from Artedi's MS.), Artedi 1738, Gronow 1754 and 1763, and Gmelin 1788, for chimaeroids, sharks, rays, sturgeons and lampreys. (In 1758, Linnaeus substituted his new term "Amphibia Nantes" which few authors adopted.) Chondropterygii is the oldest, and so far as the entire literature of ichthyology is concerned, the most generally used and most time-honored term for the group later called Plagiostomi and Elasmobranchii. It was used by Walbaum 1792, Cuvier 1798, 1817, 1829 (who removed the sturgeons in 1798), Richardson, Günther (1870, Cat., vol. 8, p. 348; cyclostomes removed), Garman 1904, 1911, 1913, and dozens of others. Plagiostomi Meckel 1809, Elasmobranchii Bonaparte 1839, and Chondrichthyes Goodrich 1909 are all relatively recent synonyms. None of them has been used as long or as consistently for this group by systematic ichthyologists, although Elasmobranchii has of late been more widely employed by anatomists and Chondrichthyes by paleontologists. Utilization of Chondropterygii as the class name would free Elasmobranchii and Plagiostomi for included groups, as indeed has been done by Joh. Müller and Garman in using Plagiostomi, or a variation of it, for the sharks and rays alone (minus the chimaeroids). Garman 1904 (Bull. M.C.Z., vol. 41, p. 267) gives an incomplete but useful history of some of these names.

CHONDROSTEI Joh. Müller 1846 (Ueber den Bau, etc., pp. 147, 203). Order. Included sturgeons and paddlefishes. A later but better known term than Sturiones. Equivalent also to Acipenseroidei Traquair 1879 and Chondroganoidei Gill 1872, in the original sense of these names, but these may be modified to fit lower categories. Many authors over the past have assigned different limits to the group.

CLADISTIA Cope 1871 (Ichthyol. Lesser Antilles, p. 450). Order. Proposed solely for Polypteridae. An exact synonym of Polypterini Huxley 1861, but the latter was proposed as a family only. Polypterini Bonaparte 1839 was proposed as a subfamily only.

COELACANTHINI Huxley. See Actinistia.

COELOLEPIDA. (Not checked.) This name will perhaps be little used because Westoll has recently shown (Trans. R. Soc. Edinburgh) that they are very possibly merely larval forms of anaspids, cephalaspids, etc.

CRANIATA (Author not found). This term was in use as early as 1887 (Cope, Origin of the fittest, p. 323, in a section of that book first published in the Amer. Nat. in 1885). It was probably used even earlier, perhaps by Ernst Haeckel or Thomas Huxley. Gadow (1898, Classif. vertebr., p. 2) uses the form Craniota.

CROSSOPTERI Lütken 1868 (Vid. Medd. Nat. For., Copenhagen, 1868). Based on "Crossopterygidae" of Huxley which is inadmissible because proposed in form of a family name. Modified to Crossopterygia by Cope 1871, and to Crossopterygii by Hoernes in 1876. Lütken's original form should be re-

tained, for it is in perfectly good form. Most of the authors who have used and discussed the group, up to 1930, were thinking principally of the living Polypterus, recently removed from the group by Goodrich. However, both Huxley and Lütken intended the name for an important fossil group to which they believed Polypterus belonged. The emendation by removal of Polypterus and Erpetoichthys is permissible.

CROSSOPTERYGII or CROSSOPTERYGIA. See Crossopteri.

CYCLOGANOIDEI Gill 1861 (Cat. fishes E. coast N. Amer., p. 21). Order. Included only Amiidae. Equivalent to the later Halecomorphi Cope. Used widely by Gill, Jordan and Evermann, perhaps almost as widely as Halecomorphi. Lately it has gone out of use.

CYCLOSTOMATA Günther 1870 (Cat. fishes, vol. 8, p. 499). Subclass. An emendation of Cyclostomi of Bonaparte, J. Müller, and Owen, which see.

CYCLOSTOMI Bonaparte 1832 (Saggio II, p. 41). Order. For lampreys and hagfishes. In 1846 J. Müller cited this name as equivalent to his new term Marsipobranchii, which see. The name apparently was first used, in the French vernacular, by A.M.C. Duméril 1806 (Zool. analyt., pp. 100-101), for a family, "Cyclostomes", and is so used also by Cuvier 1817 (Règne anim., vol. 2, p. 116). The form Cyclostomata was a much later emendation, the first usages I have found so far (much literature still to be checked) is by Günther 1870 (Cat., vol. 8, p. 499) and Fitzinger 1873 (Versuch einer nat. Classif. Fische, p. 53). Owen 1866 (Anat. vert., vol. 1, p. 9) still used Cyclostomi, but authors subsequent to 1870 usually used the emended form. The first latinization of the term was Cyclostoma Latreille 1825 (Fams. nat. règne anim., p. 111), but this form has never gained acceptance.

CYPRINIFORMES Goodrich 1909 (Lankester's Treatise, p. xi, 371). Suborder. A renaming of Ostariophyseae. Not equivalent to Cypriniformes Regan of 1911, which is a superfamily formed to include only cyprinids, suckers, and loaches.

CYPRINODONTES Jordan 1923 (Classif. fishes, p. 157). Order. Jordan resurrected this old term from papers of Agassiz in the 1830's. However, Agassiz's use was solely as a familial name, before the adoption of the -idae ending for families. The first suggestion of a name superior to family grade for these fishes was Microcyprini Regan 1909, which see. Practically no one, save American writers, has used Jordan's term.

CYPRINOIDEI Regan 1909 (Ann. Mag. Nat. Hist., ser. 8, vol. 3, p. 77). Suborder. To include cyprinoids, characins and gymnotids. A synonym of Plectospondyli Cope, which see. Later modified to Cyprinoidea by Regan 1911.

DERMOPTERI Joh. Müller. A forgotten term, not yet checked; used originally for the group he later called Marsipobranchii. (See Cope 1871, Trans. Amer. Philos. Soc., vol. 14, p. 445).

DIPNEUSTA E. Haeckel 1868 (Natürl. Schöpfungsges., pp. 435, 441, 447). A synonym of Dipnoi, which is said to be preoccupied.

DIPNOI Joh. Müller 1846 (Ueber den Bau, etc., p. 201). Subclass. Included only lungfishes. Not Dipnoa of Owen 1866 which apparently included only the Amphibia.

ELASMOBRANCHII Bonaparte 1839 (Selachor. tab. analyt., p. 13). Subclass. Included rays, sharks and chimaeroids. Equivalent in rank to his other subclasses Lophobranchii, Pomatobranchii (most bony fishes), and Marsipobranchii. Almost identical in limits with the older Chondropterygii of Artedi, Gronow, Walbaum, Cuvier, and Günther, and with Plagiostomi of Meckel 1809 and others.

EVENTOGNATHI Gill 1861 (Proc. Acad. Nat. Sci. Philadelphia, appendix). Order or suborder. For cyprinoids alone. Equal to superfamily Cypriniformes Regan 1911.

GIGANTURIFORMES Berg 1941 (Class. fishes, p. 438). Order. A renaming of Giganturoidea, which see.

GIGANTUROIDEA Regan 1925 (Ann. Mag. Nat. Hist., ser. 9, vol. 15, p. 53; also Encycl. Brit., Ed. 14, 1929). Order. For the Giganturidae. Equal to Giganturiformes, which see. Regan's name may have to be dropped because it has a subordinal or superfamilial ending.

GINGLYMODI Cope 1871 (Ichthyol. Lesser Antilles, p. 452). Order. To include only Lepisosteus. Probably to be retained as an order or suborder. [Compare Lepisosteiformes of Hay 1929 and Semionotoidea of Romer.] Equals Gill's Rhomboganoidei of 1861.

GLANENCHELI Cope 1871 (Ichthyol. Lesser Antilles, p. 455). Order. For the electric eel, excluding other gymnotids. An unfortunate division. In 1872 Gill reunited the gymnotids and called them Gymnonoti, which see.

GNATHOSTOMATA Gadow 1898 (Classif. vertebrata, p. 5). Dean 1895 (Fishes, living and fossil, pp. 64, 228) uses "gnathostomes", in the vernacular, without capitalization, as opposed to Cyclostomes (or Cyclostomi), as if gnathostomes had not previously been used as a formal systematic term. However, it seems probable that the term had been used previously, perhaps in a formal sense, in an anatomical or paleontological paper that I have not yet found. The first formal usages of Gnathostomata in the modern sense (to include all jawed vertebrates) that I have found are by Gadow 1898 and by Shipley and MacBride 1904 (Zoology, an elementary textbook, 2nd ed., table of contents and p. 366).

GYMNONOTI Gill 1872 (Arr. fams. fishes, p. 18). Suborder. For Electrophorus and other gymnotids. Equal to superfamily Gymnotiformes Regan 1911.

HALECOMORPHI Cope 1871 (Ichthyol. Lesser Antilles, p. 452). Order. To include Amiidae. An exact synonym of Cycloganoidei Gill 1861, which see.

HAPLISTIA Cope 1871 (Ichthyol. Lesser Antilles, p. 450). Order. Proposed for crossopts other than Polypterus and coelacanthids. [Is this identical with the later Rhipidistia?] Later restricted to Tarrasiidae which are now removed from Crossopterygii.

HAPLOMI Cope 1871 (Ichthyol. Lesser Antilles, p. 455). Order. For pikes, mudminnows, cyprinodontids and amblyopsids. Enlarged by Boulenger 1904 to take in the Iniomi. Cut down by Regan 1909 by exclusion of cyprinodontids, amblyopsids and Iniomi and addition of Xenomi (Dallia).

HETEROGNATHI Gill 1893 (Fams. subfams. fishes, p. 131). Suborder. Perhaps proposed elsewhere a year or two previously, or perhaps in 1861. For characid fishes. Equal to Characiformes Regan 1911.

HETEROMI Gill 1889 (Amer. Nat., 1889, p. 1016). For Notacanthidae. Lyopomi included by Regan 1909 (Ann. Mag. Nat. Hist., ser. 8, vol. 3, p. 82).

HETEROSTRACI E.Ray Lankester 1868 (Palaeontogr. Soc., vol. 21, p. 14). Proposed for pteraspids, etc.

HOLOCEPHALA Bonaparte 1841 (Iconogr. fauna Italica, introd., p. 2). Order. Included only chimaeroids. Exactly equivalent to his own order Acanthorrhini of nine years previous (Saggio, II, p. 63). However, Acanthorrhini was accepted by no one else whilst Holocephala was taken up and used by J. Müller in 1846 (Ueber den Bau, etc., p. 204; as Holocephali). Almost everyone has used the latter name in one form or other. Apparently the first term proposed especially for chimaeroids was Acanthorina Latreille 1825 (Fam. nat. règne anim., p. 111) which was emended to Acanthorrhini by Bonaparte 1832. See also Chismopnea.

HOLOSTEI Joh. Müller 1846 (Ueber den Bau, etc., p. 203). Order. To include Lepisosteus, Polypterus, and (see Müller's appendix) Amia. Later its limits were modified by others. Abandoned by Regan but still usable as a superorder or infraclass, under Teleostomi (Actinopteri). Hyoganoidei Gill 1872 is identical save for its omission of Polypterus.

HYPEROARTII Joh. Müller 1846 (Ueber den Bau, etc. p. 204). Order. For all lampreys. Perhaps proposed before 1846. Later emended to Hyperoartia but the original form is perfectly correct.

HYPEROTRETI Joh. Müller 1846 (Ueber den Bau, etc., p. 204). Order. For all hagfishes. Perhaps proposed earlier, but in any event the first recognizable ordinal name for hags. Later emended to Hyperotretia, but the original form is perfectly correct. Diporobranchia Latreille 1825 (p. 112) is a family name for hagfishes.

INIOMI Gill 1884 (Proc. U.S. Nat. Mus., vol. 7, p. 350). Suborder. For the group called by this name by Jordan, Regan, etc., but including stomiatoids, etc., which were later removed to the Isospondyli by Regan.

ISOSPONDYLI Cope 1871 (Ichthyol. Lesser Antilles, p. 454). Order. For what is now called by that name by Jordan, Regan, etc., except that what we now call Iniomi had not yet been segregated. It is an open question whether we should accept Isospondyli or Malacopterygii, which see.

LEPIDOSTEOIDEI Traquair 1877 (Quart. J. Geol. Soc., vol. 33, p. 8). Equivalent to Ginglymodi Cope 1871, but unusable for an order on account of the ending.

LYOMERI Gill and Ryder 1883 (reference not yet checked). For the gulper eels. Equivalent to Saccopharyngiformes Berg 1941.

LYOPOMI Gill 1889 (Amer. Nat., 1889, p. 1016). For Halosauridae. Included by Regan 1909 in Heteromi, which see.

LYSOPTERI Cope 1880 (Amer. Nat., vol. 14, p. 440). A name equal to Palaeoniscoidei. However, the latter name cannot be used for an order because of the superfamilial or subordinal ending and the equivalent ordinal names Palaeonisciformes and Archistia are no better known than Lysoperti.

MALACOPTERYGII (Artedi 1738; Gronow 1754) Gill 1893 (Fams. subfams. fishes, p. 130); Boulenger 1904 (Ann. Mag. Nat. Hist., ser. 7, vol. 13, p. 163; also Cambr. Nat. Hist.). Order. Originally proposed for most soft-rayed teleosts. It was used by many authors, such as Cuvier, but temporarily became eclipsed by J. Müller's Physostomi of 1846. Gill revived it for what we now call Isospondyli (plus Iniomi). Boulenger's use omitted Iniomi; the Cambridge Nat. Hist. had great popularity and Boulenger's concept became widely established subsequent to 1904. It is an open question whether we should use Isospondyli or Malacopterygii. In 1866 Owen (Anat. vert., vol. 1, p. 9) used the emended form Malacopteri.

MARSIPOBRANCHII Joh. Müller 1846 (Ueber den Bau, etc., p. 204). Subclass. For all living cyclostomes. Recognized by Müller in 1846 as a synonym of Cyclostomi Bonaparte 1832, which see. Perhaps proposed first in 1833 or 1834 (Vergl. Anat. Myxin.)

MICROCYPRINI Regan 1909 (Ann. Mag. Nat. Hist., ser. 8, vol. 3, pp. 78, 84). Order. For Cyprinodontidae and Amblyopsidae. See also Cyprinodontes. British and other European workers have paid no attention to Cyprinodontes of Jordan and have continued to use Microcyprini. (See introduction to this list for comments.)

MONORHINA Ernst Haeckel. (Not yet checked.) Apparently proposed by Haeckel as a group name for cyclostomes. Employed by Kiaer 1924 (Downtonian fauna of Norway, Anaspida, p. 129) as a "branch" (equals superclass) to include the monorhine Agnatha (anaspids, cephalaspids and cyclostomes). Also used by Goodrich 1930 and many recent writers.

MYXINOIDEA (not yet checked.) A term based on Müller's family name Myxinoidei, but apparently not used for any grade above family until long after Müller's ordinal name Hyperotreti, which see.

MYXINOIDEI Joh. Müller 1846 (Ueber den Bau, etc., p. 204). Proposed merely as a family. Perhaps proposed earlier (Vergl. Anat. Myxin.). Equivalent to the subfamily Gastrobranchini Bonaparte 1832 (Saggic II, p. 41).

NEMATOGNATHI Gill 1861 (Proc. Acad. Nat. Sci. Philadelphia, appendix, pp. 11, 56). Order. For all catfishes. Exactly equivalent to Siluroidei Stannius 1854, which see. But that name is probably not available on account of its ending, if subordinal names are to end in -oidei or -oidea.

OSTARIOPHYSEAE (Sagemehl) Eigenmann 1890 (Zoe, vol. 1. p. 10). Order or suborder. Sagemehl used only the vernacular German "Ostariophysen". Eigenmann was apparently the first to latinize the name. Bridge and Haddon 1893 (Web. oss. silur. fishes) used Eigenmann's spelling. Jordan and Evermann 1896 (Fishes N. Mid. Amer., vol. 1, p. 114) emended the spelling to Ostariophysi. Equal to suborder Cypriniformes Goodrich 1909.

OSTARIOPHYSI. See Ostariophyseae.

OSTEICHTHYES Howes 1894 (Science Progress, vol. 1, pp. 78, 87). This term was taken up by Goodrich 1909 (Lankester's Treatise, p. ix) for bony fishes, including Dipnoi, Crossopterygii, etc. Practically equivalent to Pisces as used by Linnaeus 1758, to Ossei Bonaparte 1832 (Saggio II, p. 42), to Pomatobranchii Bonaparte 1839 (Selach. tab. analyt., p. 15), to Ostinopterygii MacLeay 1841 (Ann. Mag. Nat. Hist., 9, p. 197), to Teleostomi Bonaparte 1839, etc., etc. Any of these and perhaps other available terms could have been modified slightly and used instead of this superfluous term. Finally, the Latin term Ostichthes was proposed by Duméril 1870 (Hist. nat. poiss., vol. 2, p. 291) solely for the group called Holostei by Müller in 1846.

OSTEOLEPIDOTI Goodrich 1909 (Lankester's Treatise, p. x). Order. To include Haplistia and Rhipidistia, as suborders. The Haplistia (Tarrasiidae) are now placed near the paleoniscoids, leaving Goodrich's term synonymous with Rhipidistia.

OSTEOSTRACI Lankester 1868 (Palaeontogr. Soc., vol. 21, p. 14). For Cephalaspidae. Apparently more or less identical with Cephalaspidomorphi, which see.

OSTRACODERMI Cope 1889 (Amer. Nat., vol. 23, p. 852). This well-known term was apparently soon found to be preoccupied and was replaced by Ostracophori Cope 1891 (Amer. Nat., vol. 25, p. 646), but meanwhile it had been taken up by Woodward 1891 (Cat. foss. fish., vol. 2, pp. xvii, 159) as an order to include Cephalaspidae, Trematapidae, Asterolepidae, and Ceraspidae, and so gained wide currency. Aspidoganoidei Gill 1876 (Johnson's Univ. Encycl., vol. 4, p. 185) is a prior term, but forgotten. Apparently a synonym of Osteostraci.

OSTRACOPHORI Cope 1891 (Amer. Nat., vol. 25, p. 646). To replace the preoccupied name Ostracodermi Cope, which see.

PALAEONISCIFORMES Hay 1929 (Second bibl. and cat. fos. vert. N. Amer., p. 685). Suborder. Equivalent to Lysopteri, Archistia, and Palaeoniscoidei, which see. So far as I know, Palaeonisciformes has been used only by two writers since Hay (Berg and Moy-Thomas).

PALAEONISCOIDEI Goodrich 1909 (Lankester's Treatise, pp. x, 309). Suborder. For the Palaeoniscidae, Platysomidae, and Catopteridae. This should be the name used for the lowest order of Pisces, but the -oidei ending, now used for superfamilies or suborders, prohibits. Equivalent to Lysopteri Cope 1880.

PETROMYZONINI Bonaparte 1832 (Saggio II, p. 41). Proposed solely as a family name for the lampreys and so used by Joh. Müller in 1846 (Ueber den Bau, etc., p. 204).

PETROMYZONTIA (also PETROMYZONTIDA). A term based on Bonaparte's and Müller's family name Petromyzonini, but apparently not used for any grade above family until long after Müller's ordinal term Hyperoartii, which see.

PHYSOSTOMI Joh. Müller 1846 (Ueber den Bau, etc.). For lower teleosts pos-

sessing an open duct between the air-bladder and gut. See under Malacopterygii.

PISCES (Artedi) Linnaeus 1758 (Syst. nat., ed. 10, tom. 1. p. 239). Class. Originally proposed by Linnaeus for all fishes except sharks, rays, lampreys, hagfishes, chimaeroids, sturgeons and Lophius. Except for the exclusion of the small groups of sturgeons and Lophius, Pisces of Linnaeus was exactly co-extensive with what the latest authors call Osteichthyes, and should be retained for that group.

PLACODERMI McCoy 1848 (Ann. Mag. Nat. Hist., ser. 2, vol. 2, pp. 6 and 278). For a number of genera placed by Watson in his Aphetohyoidea, but not including acanthodians. McCoy's concept of the group now called Placodermi was most surprising for his day.

PLAGIOSTOMI Meckel 1809 (Tab. I-IV Frioriep and Meckel's Vorles. vergl. Anat. Cuvier, tab. iv). (Not seen.) Evidently was proposed for sharks and rays, excluding chimaeroids. See under Chondropterygii.

PLECTOSPONDYLI Cope 1871 (Ichthyol. Lesser Antilles, p. 454). Order. To include cyprinoids, loaches, characins and part of what are now called gymnotids. Equivalent to Cyprinoidei Regan 1909. Includes Eventognathi, Heterognathi, Glanencheli and Gymnonoti of Gill and Cope.

PROTOSPONDYLI Woodward 1895 (Cat. foss. fish., vol. 3, p. 48). Order. Proposed for Semionotidae, Macrosemiidae, Pycnodontidae, Eugnathidae, Amiidae, and Pachycormidae. This is probably a polyphyletic assemblage according to the recent work of Brough and others, and seems best abandoned. Amia is best put in an order by itself, with Sinamia. See Halecomorphi.

PTERASPIDOMORPHI Goodrich 1909 (Lankester's Treatise, pp. ix, 195). Order. For coelolepids, drepanaspids, psammosteids, pteraspids, i.e., all diplorhine Agnatha. A synonym of Heterostraci Lankester 1868, which see.

RHIPIDISTIA Cope 1887 (Amer. Nat., vol. 21, p. 1017). For the osteolepids, etc. This would seem to be almost or quite an exact synonym of Sarodipterini Huxley 1861. However, Huxley's term was proposed only as a family name.

RHOMBOGANOIDEI Gill 1861 (Cat. fishes E. coast N. Amer., p. 21). Order. Included Lepisosteus and Polypterus. Not recently used, its components being now more generally known as Ginglymodi and Cladistia. Should probably be abandoned.

SCYPHOPHORI Cope 1871 (Ichthyol. Lesser Antilles, p. 454). Order. For mormyrids and gymnarchids only. Equivalent to Regan's Mormyroidea of much later date.

SCOMBRESOCES. See under Synentognathi.

SEMIONOTOIDEA (Author not yet traced; perhaps Romer 1945, Vert. paleo., p. 580). Also as Semionotida Moy-Thomas 1939 (Palaeozoic fishes, p. 127). Order (Romer). Suborder (Moy-Thomas). Used to cover Lepisosteus and Semionotidae. Ginglymodi is much older and better known.

SILUROIDEI Stannius 1854 (Handbuch der Zootomie, von Siebold u. Stannius. Zweiter Theil, Wirbelthiere, von Stannius. Erstes Buch, Fische). This has not been checked in the original but the name probably was used solely in a familial sense, and is unusable according to Simpson's rules. So also with Huxley's use in 1858. There is little doubt that Nematognathi has priority as an ordinal name. Siluroidea Gill 1873 and Siluroidei Regan 1909 are subsequent.

STURIONES Bonaparte 1832 (Saggio II, pp. 40, 63). Order. For sturgeons and paddlefishes. Equivalent to Bonaparte's Eleutheropomi on the same page, the latter being a latinization of Duméril's French vernacular term of 1806 (Zool. analyt., p. 105). Older than Chondrostei of Müller 1846. Equivalent also to Chondroganoidei Gill 1872. But Chondrostei is by far the best known term.

SYNENTOGNATHI Gill 1866. (Ref. not checked.) The term Scombresoces was apparently proposed and used only in a familial sense.

TELEOSTEI Joh. Müller 1846 (Ueber den Bau, p. 201). Subclass. To include all bony fishes save lungfishes, garpikes, Polypterus, Amia, sturgeons and paddlefishes. An almost universally recognized group, but discarded by Regan in 1923 (P.Z.S.). Still may be used as infraclass or superorder within Teleostomi (Actinopteri)

TELEOSTOMI Bonaparte 1839 (Selach. tab. analyt., p. 13). Proposed as a "Sectio", which equals a superorder. Included Agassiz's groups Ganoidei, Ctenoidei and Cycloidei; sturgeons, plectognaths and lophobranchs were excluded. Although less inclusive and less valid as a grouping than Bonaparte's forgotten Pomatobranchii of the same paper, Teleostomi was taken up and emended by Richard Owen in 1866 (Anat. vert., vol. 1, p. 7) as a subclass to include all teleosts and ganoids. (Lungfishes were only equivocally excluded by Owen; these fishes were unknown to Bonaparte.) It would seem that Teleostomi ought to supplant Actinopteri of Cope, for only slight modification, if any, of Owen's concept is necessary to make these terms synonymous. Teleostomi has had long and prominent usage.

TREMATOPNEA (Duméril 1806, Zool. anal., pp. 97, 101) Rafinesque 1815 (Analyse de la nature.) Order. Duméril included cyclostomes, sharks, and rays; he used the French vernacular term "Trematopnes". Rafinesque latinized the name as Tremapnea, which was almost certainly a lapsus or misprint for Trematopnea. Bonaparte 1832 (Saggio II, p. 63) called it Trematopnei, with the same limits that Duméril used. Garman used it for sharks and rays as a term cognate with Chismopnea, which see. Regan 1906 (P.Z.S., p. 722) used Trematopnea as the "series" (that is, a superorder) for selachians other than chimaeroids. Hay 1929 (Second bib. cat. fos. vert., p. 528) used Trematopnei in the same sense. Outside these five authors the name has had little currency.

VERTEBRATA Lamarck. So listed without date or reference, by Hay 1929 (Second cat. and bib. fos. vert.). I have not yet had time to investigate this point. The term as used today for the craniate chordates is identical with Craniata.

XENOMI Gill 1885 (reference not checked). Order. To include only Dallia. Now placed in Haplomi.

THE PRIACANTHID FISH GENUS PRISTIGENYS. — This brief note is published principally to call the attention of workers on living fishes once more to the correct name of the genus of Priacanthidae still called *Pseudopriacanthus* even in the most recent literature, and partly to collect some of the scattered information on the genus. The fact that the genus was first named for a fossil species, and that the generic name given by Bleeker to the living forms is a synonym, was prominently pointed out over twenty years ago by E. I. White (1936, Ann. Mag. Nat. Hist., ser. 10, vol. 18, pp. 48-54), but few ichthyologists seem to be aware of it. The genus should stand as:

Genus PRISTIGENYS Agassiz, 1835

Pristigenys Agassiz, 1835, Neues Jahrbuch für Mineralogie, 1835, p. 299; and 1839, Poissons Fossiles, vol. 4, pp. 133, 134, 136 [type species by monotypy, *Pristigenys macrophthalmus* Agassiz, equals *Chaetodon striatus* Volta (*nec* Linnaeus), equals *Chaetodon substriatus* de Blainville].

Pseudopriacanthus Bleeker, 1869, Verslagen en Mededeelingen der Koniglijke Akademie van Wetenschappen, Afd. Natuurkunde, 2 Reeks, Deel 3, p. 241 [two species originally referred to the genus: *Priacanthus niphonius* Cuvier (and Valenciennes) and *Priacanthus altus* Gill; type species *Priacanthus niphonius* C. (V.) by subsequent designation of W. L. Morrison, 1889, Proc. Acad. Nat. Sci. Philadelphia for 1889, p. 163].

The genus has existed since the Eocene (Lutetian), where it is found at Monte Bolca (in "La Pesciara", Bolca, near Verona, Italy). White's description and figures (see reference above), leave no question of the close relationship of the Fossil form to the Recent ones. Incidentally, the finest figure of a Recent member of the genus is the Ford and Griesbach lithograph of Gűnther's nominal *Pristigenys meyeri* from Celebes (Gűnther, 1871, Proc. Zool. Soc. London, pl. 57). The genus is well diagnosed and the older literature on the Recent species is cited by Boulenger (1895, Cat. Fishes British Museum, ed. 2, vol. 1, p. 358).

The species probably all grow to rather large size (a foot or more) but young ones up to 40 or 50 mm. in length are much more commonly seen. Great changes in comparative body depth and other proportions occur with growth. The body of the young of 30 or 40 mm. is almost circular, and the body remains very deep up to a length of 150-200 mm. The large example of the nominal *P. refulgens* figured by Sauvage (1887-1891, Poissons, in: Grandidier, Hist. de Madagascar, pl. 5) is much more elongate. Probably all the species normally inhabit deeper waters on the continental shelf. The living fishes are red or reddish yellow in color. Darker vertical bands are sometimes seen in the young; these are probably evanescent to a greater or lesser degree.

At the present time the genus is known from the western Pacific in southern Japan and Celebes, in the Indian Ocean (Mauritius, Reunión, and East Africa), and on the warmer Atlantic and Pacific coasts of America. Examples of the Atlantic American species are found in summer as far north as New England, brought by Gulf Stream waters. It seems remarkable that the Indo-Pacific form has apparently not yet been recorded from Australia, or more widely in Indonesia, for such records would be expected on zoogeographical grounds. It would not be surprising to find the genus to exist on the coast of tropical West Africa.

The Greek word *genus* (jaw, cheek or jowl) is of feminine gender. Adjectival specific names in Latin or of latinized form coupled with the generic name *Pristigenys* should bear feminine endings.

The following four forms are known to me:

1. *Pristigenys substriata* (de Blainville, 1818).

For the synonymy of this form see White (above) and Eastman's 1905 paper cited by White. From the Lower Lutetian (Eocene) at Monte Bolca (Bolca, near Verona). The type is in Paris.

2. *Pristigenys niphonia* (Cuvier, 1829).

For synonymy, see Weber and de Beaufort (1929, Fishes of the Indo-Australian Archipelago, vol. 5, p. 390). The nominal *Pristigenys refulgens* (Valenciennes, 1862) and *Pristigenys meyeri* (Gűnther, 1871) seem to be referable to this Indo-Pacific species, ranging from East Africa, Réunión and Mauritius to Celebes and Japan. The types of *P. niphonia* and *P. refulgens* are in Paris, that of *P. meyeri* in London.

3. *Pristigenys serrula* (Gilbert, 1890).

This form seems to have been named twice, by C. H. Gilbert in 1890 (see Jordan and Evermann, 1896, Bull. U.S. Nat. Mus. no. 47, part 1, p. 1239) and by H. W. Clark (1936, Proc. California Acad. Sci., ser. 4, vol. 21, p. 388). The type of *Pristigenys serrula* is in Washington, that of *Pristi-*

Genys lucasana (Clark) in San Francisco. The species ranges from southern Lower California (Cape San Lucas, Baja California, Mexico) to Colombia in the Pacific. The ending of the specific name *serrula* (a noun in apposition) apparently would remain the same, no matter what the gender of the generic name may be.

4. *Pristigenys alta* (Gill, 1862).

This species alone appears to have been given but one specific name (see Jordan and Evermann, cited above; and Morrison, 1889, Proc. Acad. Nat. Sci. Philadelphia, 1889, p. 163). It is a West Indian form, found northward in summer as far as southern New England. The type, from Narragansett Bay, is in Washington.—George S. Myers.

TWO NEW ANNUAL CYPRINODONT FISHES FROM NORTHERN COLOMBIA

By George Dahl[1]

In some of the semi-permanent ponds typical of the savannah country round Sincelejo, the author has lately obtained two species of cyprinodont fishes, both of which are apparently new to science.

One of these species is a member of the genus *Austrofundulus* Myers and represents, as far as the author is aware, the first find of this genus outside of Venezuela. The other belongs to the genus *Rachovia* Myers but is different from *R. brevis* (Regan) from the other side of the Magdalena River.

Austrofundulus myersi, new species

HOLOTYPE: Female, 53 mm. standard length, and allotype, male, 66 mm. standard length, collected by the author and his son Leif Dahl in a small semi-permanent pond at Sincelejo, within the boundary of the town, June 28th, 1956.

PARATYPES: Many, same locality (including 10 specimens, SU 49513).

DESCRIPTION: Head slightly more than 3 (female) to slightly less than 4 (male) in standard length. Depth about 3.75. Head about 1.5 longer than wide, the width of the head equal to (or a few percent less) than its greatest depth at occiput. Diameter of eye very nearly 4 in length of head, equal to or a little longer than snout or half the interorbital space. Profile slightly concave, more so in males than in females, because of a fleshy swelling at occiput in the former sex.

Dorsal rays generally 15 to 16, anal rays 17 (16 in one male paratype). Pectoral rays 16-16 (17-17), pelvic rays 7-7 (7-7). Lateral scales 34-36. Scales between origin of anal and dorsal 12 (13), across breast between pectorals 7 (7), between pectorals and pelvics 11 (12), in a zigzag row round caudal peduncle 17 (19).

Gill-rakers 3-14. Caudal fin truncate in males, truncate-rounded in females. Anal and dorsal fins slightly to acutely pointed in males, the anal more so; both rounded in females. The lower jaw projects considerably in front of the upper, so that the mouth opens obliquely upwards.

Both jaws with an outer row of short, blunt, subconical teeth, rather

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dull-pointed and very widely spaced. In both jaws there is an inner band, almost reduced to a single row, of backward-curving, considerably larger teeth, laterally compressed (especially in the proximal part) and much closer to each other than the teeth in the first row.

COLOR: Of the live specimens, kept in aquarium for study:

Female: General coloring rather drab olive, faintly mottled on sides, lighter grayish on lower parts of sides, abdomen pale. Back dark olive. Fins pale yellow-brown, dorsal and proximal part of anal mottled with irregular dark spots. (The extent and intensity of the mottling varies very much.) Pectorals and pelvics pale, transparent. Eye pale yellow to almost whitish with a dark stripe continued on the cheek (very faint in some specimens). No ocellus. Lower jaw bluish.

Male: General color greenish olive, with darker spots in longitudinal, almost confluent rows. Bright yellow spots on caudal fin. Back very dark olive, dorsal fin light olive with rows of dark brown spots in lines; the proximal line is formed by large round spots, the distal ones much smaller and irregular. The scaled part of caudal (more than half in large males, less in smaller ones) is greenish olive, the naked part blue on the lower half or two-thirds, the upper border rosy red. These blue and red colors, normally faint and pale, get very much accentuated when the fish is excited. Anal fin bright red with pale bluish border. Pectorals and pelvics reddish, semi-transparent. A dark, almost vertical bar through the yellow eye.

The preserved (formalin or alcohol) specimens soon lose their colors and fade into grayish, when only the dark mottlings and spots persist.

One dissected female of 53 mm. length contained about 30 eggs with a rather tough, shell-like membrane and a comparatively large amount of yolk.

FOOD: Aquatic insects and very especially mosquito larvae. Small guppies (*Mollienesia caucana*) are also taken. If food is scarce, even comparatively large prey (small females of *Rachovia splendens*) are attacked. In its natural habitat, the fish can be attracted by beef liver or muscle as bait, but does not easily take this food in the aquarium.

ECOLOGY: Up to date only found in pond which dries out completely for months during the dry season, from January to April. There are indications that spawning may occur twice a year, in December and in July (there is sometimes a less accentuated dry season from late June or early July to end of August or early September). Females with mature eggs have been found from June 28th to July 16th, and also from October to December 23rd. In July, spawning can be induced by diminishing the quantity of water in the aquarium. If this is kept full, spawning occurs when a large number of specimens are kept in it, the males turning quite bellicose. If the water is reduced, spawning takes place within a few hours or a day.

It does not seem probable that in nature the fishes generally die after the first spawning; in the aquarium they often (but not always) do so.

The author has taken the liberty of naming this new species for Professor George S. Myers, whose works have helped him more than anything else in his endeavors.

MEASUREMENTS: See Table 1.

Austrofundulus myersi differs from the other known species of the genus in the underslung lower jaw, the short snout, lesser depth of head, much less difference between snout-anal and snout-dorsal, and in several other characteristics.

Rachovia splendens, new species

HOLOTYPE: Female, 35 mm. standard length, collected in the same pond and on the same date as the type of *Austrofundulus myersi*. Allotype, male,

TABLE 1

Measurements on Holotype and Allotype of *Austrofundulus myersi*, compared with the Holotypes of *A. transilis* Myers, *A. transilis limnaeus* Schultz and *A. stagnalis* Schultz, as given in Schultz, 1949, p. 86.

	Holotype *myersi* female	Allotype *myersi* male	*transilis*	*limn.*	*stagn.*
Standard length in mm.	53	66	40	61	31.5
All following measures in % of standard length					
Length of head	32.1	27.3	33.2	31.1	36.2
Greatest depth of body	28.35	27.2	32.0	36.1	29.5
Length of snout	6.61	6.75	9.5	9.02	11.1
Diameter of eye	7.18	6.75	9.75	7.54	8.3
Postorbital length of head	18.90	15.6	17.0	17.9	21.9
Width of fleshy interorbital space	13.23	14.25	14.3	13.9	14.6
Length from base of last anal ray to midcaudal base	22.7	18.75	23.8	23.1	21.3
Least depth of caudal peduncle	15.1	15.0	16.7	17.1	17.8
Greatest width of head	22.7	19.5	20.0	20.5	23.8
Depth of head at occiput	22.7	21.0	25.0	26.2	26.1
Length of upper lip	9.25	9.00	9.50	9.02	11.1
Greatest width of upper lip	2.46	2.75	2.50	1.97	3.17
Snout to dorsal origin	66.15	52.5	68.2	67.4	68.6
Snout to anal origin	64.4	49.5	60.2	60.6	61.9
Snout to pectoral insertion	37.8	31.5	32.8	32.8	36.8
Snout to pelvic insertion	56.7	43.5	53.8	51.6	53.6
Longest ray of dorsal fin	20.8	22.5	20.0	23.3	24.8
Longest ray of anal fin	22.7	24.75	17.5	19.0	28.6
Longest ray of pectoral fin	20.8	19.5	15.0	23.0	23.8
Longest ray of pelvic fin	11.34	13.5	11.3	12.3	12.7
Length of depressed dorsal fin	30.7	31.5	31.5	37.7	36.5
Length of depressed anal fin	28.35	36.0	30.8	33.0	40.0
Length of base of dorsal fin	19.85	18.75	18.8	23.4	21.3
Length of base of anal fin	17.95	19.20	20.0	23.4	20.0

50 mm. standard length, same locality and date.

PARATYPES: Several hundred, from ponds in the San Jorge, Sinú, Pechilín and Canalete systems. (Including 16 specimens: SU 49519 from same locality as holotype.)

DESCRIPTION: Head depressed, deeper than broad; length of head about 3.8 in standard length, equal to depth of body. Depth of head about 1.2 in length of head (females) or nearly equal (males). Dorsal rays 11 (four females, two males) to 12 (two males). Anal rays 14 (four females) to 16 (15 in three males, 16 in one). Dorsal beginning above 6th anal ray. Pectorals 15-14 (14-14) in female, 15-16 (15-15) in male. Pelvics (7-7) 7-7. Caudal rays 26 (24, 26, 26, 26), covered with minute scales at base only (females) or to half its length (males), scaling of tail increasing with size in males.

Thirty-three to 35 scales in the long series, with lateral pores clearly

visible in the last about 20 scales. Seven scales in zigzag between pectoral bases.

Body laterally compressed, tail much more so, with caudal peduncle very high and thin. Caudal fin truncate to slightly rounded in females, in the males the median part of the caudal shows a slightly convex curvature, while the outer parts form streamers. These vary in length but are most pronounced in large males. The anal fin also carries a short pointed streamer in the male. There are 10 scales between anal and dorsal. The anal is rather fleshy, especially the proximal part.

An uneven band of conical recurved teeth in each jaw, apparently degenerating in the larger specimens. There are only very faint vestiges of villiform teeth.

COLOR: In the live specimens, as observed in aquarium:

Female: General color above darkish olive, sides light slate-gray to steel-gray. No ocellus. Fins unspotted. A dark oblique stripe through eye. Iris yellow.

Male: General body color light blue, tending to olivaceous on the back, with red spots in oblique lines. Head bluish violet to purple, opercular flap underlined with brilliant green, spots on cheek-region greenish yellow.

TABLE 2

Measurements of Holotype and Allotype of *Rachovia splendens*.

	Holotype female	Allotype male
Standard length in mm.	35	50
(All following measurements are expressed in hundredths of standard length)		
Length of head	27.1%	26.2
Greatest depth	27.0	26.1
Length of snout	5.7	6.0
Diameter of eye	8.55	7.0
Interorbital distance	12.8	15.0
Postorbital length of head	14.25	15.1
From base of last anal ray to midcaudal base	22.8	27.0
Least depth of caudal peduncle	15.7	18.1
Depth of head at occiput	22.8	24.0
Greatest width of head	18.5	18.0
Distance from snout to dorsal origin	71.3	70.1
" " " " anal origin	65.6	61.9
" " " " pectoral insertion	31.4	30.9
" " " " pelvic insertion	57.0	51.0
Longest anal ray	17.1	26.0
Longest dorsal ray	17.1	21.9
Longest pectoral ray	15.7	22.0
Longest pelvic ray	11.4	12.1
Depressed dorsal	25.7	32.3
Depressed anal (including streamer in male)	28.5	41.2
Dorsal base	12.8	20.0
Anal base	20.0	20.0

Dorsal fin olive with dark transverse-oblique, mottled lines. Caudal fin brownish red at base, further out blue-black with a design near the edge of brilliant, light bluish green spots and stripes of very small size. Anal fin base light blue, then a mottled reddish brown band, then a narrow mottled light blue band. Border midnight blue to black. Pectorals and pelvics mottled; an oblique dark band through eye.

When the male is dying in alcohol or formalin, the colors darken rapidly, passing through stages of blue and dark purple. The formalin-preserved specimens soon turn grayish, males much darker than females and with very dark fins.

BIOLOGY: Generally found in ponds with very rich vegetation. It is easily kept in an aquarium of reduced size. As food it prefers mosquito larvae but also takes other aquatic insects and, when hungry, very small *Mollienesia caucana* (those less than 10 mm. in length preferred). Where many males inhabit small ponds, and especially in an aquarium, the smaller ones often get their caudal streamers torn off by the larger ones. The longest anal, as well as dorsal, ray is the fourth from behind; but anal streamers are sometimes lost.

There can be very little doubt that this is an annual species, but definite proof (such as breeding from debris in the bottom of a pond) is still lacking.

This species is probably quite common in the savannah country west of the Magdalena, but is rarely observed because it lives among filtering masses of *Eichhornia* and other floating plants.

The name *splendens* refers to the brilliant colors in the male.

MEASUREMENTS: See Table 2.

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BATHYLYCHNOPS EXILIS, A NEW GENUS AND SPECIES OF ARGENTINOID FISH FROM THE NORTH PACIFIC

By Daniel M. Cohen

The specimen described below is the only known example of an apparently undescribed genus and species of bathypelagic fishes. It is part of a collection lent to the author for study by the Pacific Oceanic Fisheries Investigations of the U.S. Fish and Wildlife Service. Further studies on the collection are now in progress.

Because of the resemblance of *Bathylychnops* to *Dolichopteryx* Brauer, it has been necessary to examine specimens of the latter more critically. I have been fortunate in having at my disposal two cleared and stained examples of this rare genus collected by The Department of Tropical Research of The New York Zoological Society and deposited in the Natural History Museum of Stanford University (SU 45289, *Dolichopteryx longipes* from Bermuda, and SU 45288, *Dolichopteryx* sp. from near the Galapagos Islands). I have also been able to examine specimens of an unidentified species from off the coast of California.

In comparing the cleared specimens with the figure of the skull of *Dolichopteryx binocularis* given by Beebe (1933, Fig. 18) I find two points which require comment. Beebe has identified the most anterior tooth-bearing bone of the upper jaw as the premaxillary. Examination of the osteological preparations mentioned above suggests that the bone which Beebe calls the premaxillary might be more properly interpreted as the head of the vomer. As in *Macropinna* (Chapman, 1942) the dorsal edge of the head of the vomer is securely fastened to the mesethmoid, while the elongate, scale-thin shaft (present in the genus but not figured by Beebe) extends posteriorly and makes contact with the equally thin parasphenoid. I find no premaxillaries. It would indeed seem strange to find the premaxillary bearing teeth and comprising the entire upper border of the jaw if the suggestions of several authors (Chapman, 1942; Grey, 1952; Hubbs, 1953) that *Dolichopteryx* is a member of the argentinoid assemblage are true. In the argentinoids I have examined the premaxillaries are present but weakly developed in some genera, absent in others, and I know of no members of this group with teeth on the premaxillary.

The second point concerns the reported presence of supramaxillaries. Beebe (1933) has figured them in *Dolichopteryx binocularis* (Fig. 18) and also in *Bathylagus glacialis* (Fig. 36), another argentinoid species. Supramaxillaries are not found, to my knowledge, in any other argentinoid fishes; therefore, their reported presence in the above two species seems rather incongruous. I have examined one of Beebe's cleared and stained specimens of *Bathylagus glacialis* (SU 46177) and I find no supramaxillary. Instead there is a poorly defined median ridge which has stained slightly darker than the surrounding area and which might have been interpreted as a suture. The maxillary of *Dolichopteryx* is a thin, scale-like bone, evidently deciduous, as I was able to find only one on the three specimens which I examined. Supramaxillaries were not observed. The stain had faded and it was not possible to see what might have been mistaken for sutures. Chapman (1942) noted a line on the maxillary of *Macropinna* which appeared to divide the bone into two parts; upon further investigation he found the line to be only pigment in the membranous covering of the bone and not a suture. A similar explanation may account for the presumed supramaxillaries of *Dolichopteryx binocularis*.

Genus BATHYLYCHNOPS, new

Figure 1

TYPE SPECIES: *Bathylychnops exilis*, new species.

Body elongate, cylindrical anteriorly, the posterior two-thirds laterally compressed; however, the ventral surface is flat from the pectorals to the origin of the anal fin. Pectoral fins pedunculated, the peduncles originating a short distance behind the opercle with their dorsal surfaces immediately below the midline of the body. Ventral, dorsal and anal fins on the posterior third of the body. The ventral fins originate on the ventral surface of the body slightly anterior to a vertical from the origin of the dorsal; origin of the anal fin well behind a vertical from base of the last dorsal ray. Adipose fin present (its exact position is not discernible because of mutilation of the specimen). Snout elongate, mouth small, premaxillaries absent; a single row of teeth present on the vomer and on the dentaries. Maxillary present, but without teeth. It is a thin, scale-like bone, longer than wide and placed obliquely with the anterior end dorsad and the posterior end ventrad. A median ridge runs along the anterior half. Eyes large, laterally placed and directed forward and upward in the orbit; cornea projecting from the orbit so that the fish must have a very wide field of vision (Fig. 2). Although the eye protrudes, it is not tubular ("telescopic" of many authors): i.e., the lens does not project from a cylinder. A black sac, slightly smaller than the lens, is present at the

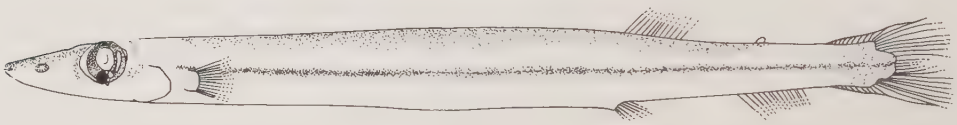


Fig. 1. Diagram of reconstruction of holotype of *Bathylychnops exilis*, USNM 114700; standard length about 216 mm.

antero-ventral segment of the eye covering that sector of the iris (Fig. 3). Projecting from the postero-ventral segment of the sac is a photophore. Two other patches of luminous tissue are also present, both on the surface of the iris. One is irregularly shaped, smaller than, and immediately posterior to the black sac. The second patch is more elongate and runs vertically, bordering the posterior edge of the pupil. Interorbital very narrow, concave, with a thin, sharp-edged ridge running down the center. Operculum thin and scale-like; preopercle running far forward. At least two branchiostegal rays, possibly more. Gill membranes badly torn, but they appear to have been broadly connected and separate from the isthmus. One pseudobranch present on each side. Thin cycloid scales present. Lateral line present. Air bladder absent.

Bathylychnops is closely related to *Dolichopteryx* Brauer. It differs in the following respects: (1) A greater vertebral count. Beebe (1933, p. 75) gives a vertebral count of 43 plus urostyle for *Dolichopteryx longipes*. A cleared and stained specimen of an unidentified species of *Dolichopteryx* from near the Galapagos Islands has 40 vertebrae plus the urostyle. *Bathylychnops* possesses 80 vertebrae plus the urostyle. (2) Eyes definitely non-tubular. In all but three instances *Dolichopteryx* has been recorded as having tubular eyes. In the original description of *Dolichopteryx longipes*, Vaillant (1888, p. 340) states, "L'oeil gauche seul existe, encore ne paraît-il pas intact....". The illustration (Pl. 27, Fig. 4) is rather incon-

Fig. 2. Dorsal view of the head of the holotype of *Bathylychnops exilis*.

Fig. 3. Lateral view of the head of the holotype of *Bathylychnops exilis*.

clusive in this regard. Norman (1930, p. 271) describes several specimens of *Dolichopteryx longipes* and figures (Fig. 3) one of them. He makes no mention of the eye, and in the figure the eye is not shown, thus leading us to speculate that his poorly preserved specimens had lost the eyes. However, in his key to the Alepocephalidae (p. 267) Norman uses the character "eyes telescopic" as one character for separating *Dolichopteryx* from the rest of the family. Roule and Angel (1930, p. 70) suggest that their specimen is too small (25 mm.) for tubular eyes to have developed. Examination of the figure leaves some doubt that the specimen is really a *Dolichopteryx*. Objections to the Roule and Angel identification have been summarized by Beebe (1933, p. 57). Thus it seems fairly safe to say that presence or absence of tubular eyes is a valid character for separating the two genera. (3) Luminous tissue in the orbit in addition to the orbital photophore. Whether all species of *Dolichopteryx* possess an orbital photophore is uncertain. There is no published record of accessory orbital photogenic tissue in any of the species. (4) A larger eye. The ratio of head to eye in various species of *Dolichopteryx* varies from 4.5 to 10.6 (data from Beebe, 1933, p. 58, and Parr, 1937, p. 34). In *Bathylychnops* the ratio is 4.0.

The name *Bathylychnops* is from the Greek *bathus*, deep; *lychnos*, lamp; *ops*, eye.

Bathylychnops exilis, new species

Figures 1-5

HOLOTYPE: USNM 114700; approximately 216 mm. in standard length; taken at 39° 08' N., 164° 51' W. (station 72) during cruise 30 of the *Hugh M. Smith*, on August 13, 1955, between 21:00 and 22:06 hours, by a 10-foot Isaacs-Kidd trawl between the surface and 100 meters. This locality is approximately 1500 miles south of Dutch Harbor in the Aleutians.

The specimen is mutilated in such fashion that any measurements beyond the anterior 72 mm. of the length are only approximate; for this reason proportions are not given and Figure 1 should not be considered proportionally accurate.

MEASUREMENTS IN MM: Head length, 43.3; greatest head depth, 15.5; postorbital head width, 15.5; interorbital, 2.1; horizontal diameter of orbit, 11.3; horizontal diameter of eye, 10.7; vertical diameter of eye, 10.0; horizontal diameter of black sac bearing orbital photophore, 4.0; preorbital, 18.5; postorbital, 13.5; snout to anterior edge of nasal sac, 7.5; length of nasal sac, 4.1; predorsal, 153; preanal, 176.6; prepectoral, 49; prepelvic, 150; preadipose, 183; body depth at dorsal origin, 16.9; body width at dorsal origin, 8.6; least depth of caudal peduncle, 11.4; width of caudal peduncle, 4.5.

COUNTS: D. 12; A. 14; pectorals, ?-13; ventrals, 7-7; gill rakers on first arch of left side 9 + 1 + 23; vertebrae, 80 + urostyle.

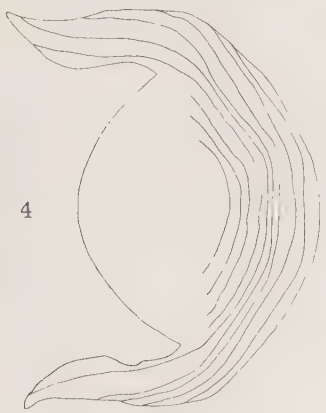
DESCRIPTION: Same as for the genus with the following additional details: a single row of about 50 small, posteriorly directed, lanceolate teeth on the vomer; a larger number of smaller teeth present in a row on the dentaries.

The specimen is almost devoid of scales; however, scale pockets are evident. The lateral line begins at the level of the upper angle of the opercle and runs horizontally along the midline of the body. Figure 4 shows a scale taken from the lateral line midway between the snout and caudal fin. The scale has a horizontal diameter of about 2.5 mm. A pair of flaps extend anteriorly approximately 1.6 mm. from their respective origins at the dorsal and ventral ends of the scale. A lateral line scale taken from the caudal peduncle has even longer flaps. Figure 5 shows a scale taken from the caudal peduncle above the lateral line. It has a horizontal diameter of about 3.0 mm. and a vertical diameter of about 1.4 mm. The circuli were

almost invisible before the scale was stained with alizarin. The scales are extremely thin and fragile.

The fins are all broken and short in the specimen.

Body color a light orange-yellow. Black pigment is present on small shreds of skin hanging from many of the empty scale pockets. Small chromatophores are distributed along the dorso-lateral contours of the fish, forming a light brown band which originates behind the head and runs to about the adipose fin. This band is not continuous over the dorsum of the fish, but is separated from a similar band on the other side by a non-pigmented area. The entire base of the caudal is more heavily pigmented than the body in general. The dorsal part of the muzzle between the tip of the snout and the anterior edge of the nasal sac is darkly colored. A scattering of chromatophores is present between the posterior edge of the nasal sac and the anterior dorsal edge of the orbit and continues ventrally along the anterior edge of the orbit. Dark patches are also present at the ventral posterior and dorsal posterior corners of the eye. The lining both of the peritoneal cavity and of the gill chamber is black. The lining of the oral cavity is more lightly colored.



Figs. 4 and 5. Scales from holotype of *Bathylychnops exilis*. Fig. 4. Taken from lateral line about 107 mm. behind snout. Horizontal diameter of scale, 2.5 mm. Fig. 5. Taken from caudal peduncle above lateral line. Horizontal diameter of scale 3.0 mm.

Although the specimen was captured at a relatively shallow depth, the fact that it was taken at night, added to the presence of large eyes and of luminous tissue makes it appear probable that this species is a true bathypelagic form, and that, as in many other bathypelagic animals, the species makes a daily vertical migration. Indeed, specimens of *Bathylagus*, which is known to be a deep-water genus were captured in the same haul with *Bathylychnops exilis*. It seems safe to predict that *Bathylychnops* will be taken at depths greater than that from which the type came.

The name is from the Latin *exilis*, slender.

ACKNOWLEDGEMENTS: I am indebted to Dr. Donald Strasburg of the Fish and Wildlife Service for sending me the specimen, to Mr. W. I. Follett of the California Academy of Sciences, and Mr. Stanley Weitzman now of Stanford, for X-ray photographs, to Dr. Robert R. Rofen of the George Vanderbilt Foundation for the loan of specimens of *Dolichopteryx*, and to Dr. Donald

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NANSENIA CANDIDA, A NEW SPECIES OF ARGENTINID FISH FROM THE NORTH PACIFIC, WITH NOTES ON OTHER SPECIES OF NANSENIA

By Daniel M. Cohen

The apparently new species herein described is part of a collection of argentinoid fishes on loan to me from the Pacific Oceanic Fisheries Investigations of the U.S. Fish and Wildlife Service. I am indebted to officials of POFI for their kindness in making their collections available to me. The present paper is a second report on my studies.

I also thank Dr. James Böhlke, Professor George Myers, Dr. Leonard Schultz, Dr. Vadim Vladykov and Mr. Loren P. Woods for allowing me to examine specimens in their care. I am indebted to Miss Margaret G. Bradbury for her care in executing the figure and to Dr. Ira L. Wiggins of the Stanford Natural History Museum for arranging financial support which made the illustration possible.

Measurements for *N. candida* are given as percent of standard length with the average stated first, followed by the range in parenthesis. Measurements for all other species are in millimeters.

In the course of studying the POFI *Nansenia* I have had occasion to review the literature on this genus and also to study the larger part of the material preserved in American museums. Although I examined specimens of six of the seven nominal species presently referred to *Nansenia*, it soon became evident that insufficient material is present for a much-needed revision. Notes are presented on several of the nominal species in the hope that they will prove of some value to a future reviser when more specimens have accumulated.

Nansenia candida, new species

Figure 1

TYPES: Holotype USNM 175362 (originally POFI catalog no. 1539), 54.4 mm. in standard length, taken from the stomach of *Alepisaurus* sp. captured on a longline at 41° 39' N., 139° 02' W. (roughly 900 miles west of Crescent City, California) during Cruise 29 at Station 36 of the U.S. Fish and Wildlife Service vessel "Hugh M. Smith", May 30, 1955, longline set between 0547 and 0641 hours, retrieving commenced at 1230, gear bearing the *Alepisaurus* in question brought on board at 1315 hours, probably caught at a depth of 65 to 70 fathoms. Paratypes USNM 175363 (3), data as for the holotype, and SU 51023 (1), alizarin specimen partially dissected, data as for the holotype.

Fig. 1. *Nansenia candida*, new species. Holotype USNM 175362 (originally POFI 1539). Standard length 54.4 mm.

DIAGNOSIS: *Nansenia candida* differs from all other nominal species of *Nansenia* excepting *N. oblita* in having the dorsal fin originate behind the midpoint of the body, as opposed to the dorsal fin originating before the midpoint of the body. *N. candida* differs from *N. oblita* in having three branchiostegal rays while *N. oblita* has four, and in having a relatively elongate body (greatest body depth 10.3-11.2 percent of standard length) while *N. oblita* is a relatively deep-bodied species (greatest body depth more than 14.5 percent of standard length).

COUNTS AND MEASUREMENTS: Counts are based on five specimens, measurements are based on three. D. 10 (10-12); A. 11 (10-11); pectoral 11 (11-12); ventral 10; gill rakers on first arch of a single specimen 12 + 1 + 17; lateral line scales 45? in one specimen, 47 in another; branchiostegals 3; vertebrae 44 in two specimens, 46 in another (not including the hypural); pyloric caeca 9 in one specimen; standard length of three specimens 54.4 mm., 62.4 mm., 72.4 mm. (other specimens too mutilated for accurate measurements); preanal 78.3 (77.3-79.5); preventral 55.7 (53.2-57.4); predorsal 52.7 (52.1-53.3); prepectoral 25.0 (24.4-25.6); head length 25.0 (24.4-25.6); snout 5.5 (5.1-5.8); eye 9.0 (8.3-9.6); depth at dorsal fin 10.7

(10.3-11.2); width behind head 8.6; interorbital 6.4 (6.3-6.5); depth of caudal peduncle 7.7 (7.2-8.3).

DESCRIPTION: Body very elongate, slightly laterally compressed anteriorly, more strongly so behind the dorsal fin. The greatest depth of the body is between the head and the dorsal origin. The greatest width of the body is behind the head. Viewed laterally the dorsal profile of the head descends in a gently sloping line, which is broken by the dorsal rim of the orbit, to a point above the nostrils, where it descends more steeply. The ventral profile of the head rises gently to the lower jaw. The interorbital region between the supraorbital canals is a rather broadly-rounded convex area, while the frontals laterad to the canals are reduced to narrow margins to which the broad, arched supraorbital bones are attached.

The eye is large. Adipose eyelids are absent. An orbital crescent is absent.

The dorsal two-thirds of the maxillary is concealed beneath the lachrymal and the jugal. The posterior tip of the maxillary is at the level of the anterior edge of the orbit in several specimens, slightly ahead of this line in others. The jaws are subequal and rounded. The flapless nares are situated at the upper corners of the blunt snout.

A single row of 28 teeth, resembling a closely spaced picket fence, is present on the dentaries. The teeth are progressively smaller from the back of each dentary to the front. Two conical teeth, intermediate in size between the largest and the smallest dentary teeth, are present at the symphysis of the mandibles. A row of conical teeth is present in the upper jaw with four teeth on each palatine, and 12 teeth on the head of the vomer. The tongue bears five small, recurved teeth on its anterior face, and has a considerable number of hemispherical papillae on its upper surface. Maxillary and premaxillary teeth are absent. The edges of the upper and lower jaws each bear a single row of papillae.

The scales are cycloid and very thin. One taken from between the lateral line and the ventral fin is roughly rectangular in shape and is approximately equal to the snout in length. Four radii run from the center of the scale to the anterior margin. The scale is indented at the junction of the radii and the anterior edge, thus giving that edge a scalloped appearance.

The pectoral fin originates slightly behind a vertical from the posterior tip of the opercle. The anterior end of the pectoral base is inserted about a third of the way up the side of the body. The base of the fin is almost vertical. The ventral fins insert on the ventral surface of the body. The dorsal fin originates slightly behind the center of the body, and the ventral fins originate ahead of a vertical from the posterior end of the dorsal base. The anal fin originates on the posterior fourth of the body. The dorsal adipose fin is situated over the anal fin base. The pectoral fin is approximately equal in length to the postorbital length of the head. The ventral fin is slightly shorter.

The inner surface of the peritoneum appears almost solid black. The stomach is thick-walled and is lined with a considerable number of fleshy, posteriorly directed papillae arranged in spiral rows. The stomach bears a small amount of widely scattered, black pigment.

Remnants of silvery pigment on the iris, on scales, and on the opercle and mandible in several specimens indicate that in life the entire fish is probably a bright silvery color. The muzzle in preserved specimens is dusky, and a concentration of pigment at the base of the caudal appears as a poorly defined dusky blotch.

The name *candida* is from the Latin *candidus*, bright or shining white, and refers to the bright, silvery appearance of this species.

Nansenia oblita (Facciolà), 1887

N. oblita is a well known fish in the western Mediterranean, particularly in the vicinity of Messina from whence it was originally described as a subspecies of *Microstoma argenteum (= Microstoma microstoma)*. Schmidt (1918) summarized the known occurrence of the species at that time. More recently Kuroda (1947) and Matsubara (1955) have given records of this species from Japan. Their specimens may represent an undescribed species.

N. oblita is one of the best-differentiated species of *Nansenia* known. It is a relatively deep-bodied form with the dorsal fin inserting behind the center of the body. The combination of these two characters sets off this species from all other known *Nansenia* species. I have examined two examples of *N. oblita* (Acad. Nat. Sci. Philadelphia 6791-2) from the Straits of Messina. The standard lengths are 45.7 and 40.0 mm. Counts and measurements for these two specimens respectively are as follows: D. 10, 10; pectoral 10?, 10; ventral 10, 10; gill rakers 8 + 22, -; lateral line scales 42?, 45?; branchiostegals 4, -; predorsal 25.4, 22.5; preanal 39.1, 33.4; preventral 30.0, 25.5; prepectoral 13.5, 11.1; head length 12.5, 11.4; snout 2.5, 2.0; eye 4.4, 3.6; body depth at dorsal fin 6.7, -; width behind head 4.5, -; depth caudal peduncle 3.5, 3.5; dorsal fin base 3.2, 3.0; anal fin base 2.5, -.

Specimens of *Nansenia oblita* are also present in the U.S. National Museum.

Nansenia schmitti (Fowler), 1934

Fowler (1934) evidently overlooked *Nansenia*, as in his description of *Microstoma schmitti*, he proposed a new subgenus, *Euproserpa*, basing it on the same characters which distinguish *Nansenia* from *Microstoma*. I follow Chapman (1948) in regarding *Euproserpa* as a synonym of *Nansenia*.

N. schmitti was originally taken in Philippine seas and is known only from the type material. The Japanese records for *N. oblita (supra cit.)* may possibly be referable to *N. schmitti*.

I have examined type material of *N. schmitti* (holotype USNM 92327, paratypes 93354-5) in the U.S. National Museum, and I find that Fowler's (1934) figure of this species is somewhat misleading as the specimens are considerably more elongate than his figure would lead one to believe. Following are data on the holotype: D. 10, A. 10, pectoral 14, ventral 11, gill rakers 9 + 1 + 17, lateral line scales 46, branchiostegals 4, standard length 194.5, predorsal 93.5, preanal 160.8, preventral 109.2, prepectoral 44.2, head length 41.5, snout 5.6, eye 17.8, body depth at dorsal fin 27.2, width behind head 19.6, depth caudal peduncle 12.8, dorsal fin base 14.0, anal fin base 10.0.

Nansenia groenlandica (Reinhardt), 1841

N. groenlandica is probably restricted to the North Atlantic; however, as later discussion will show, there is a divergence of opinion on this point. I have examined a single, mutilated specimen (collection of Dr. Vladykov) from the stomach of *Chiasmodon*. The following data were obtained: D. 12, pectorals 10-9, ventrals 11-11, gill rakers 10 + 1 + 18.

Schmidt (1918) discussed the taxonomy of this species and presented distributional data.

Nansenia macrolepis (Gilchrist), 1922

The Indian Ocean population of *Nansenia* is known from specimens taken off the East coast of South Africa, from off Zanzibar and off the Maldives. There appear to be several conflicting views on the affinities of this population. Gilchrist and von Bonde (1924) noted similarities with one of the Japanese *Nansenia*, but felt that specific recognition was warranted. Chapman (1948) synonymized *N. macrolepis* with the Japanese *N. ardesiaca*. Norman (1939), on the other hand, felt *N. macrolepis* to be conspecific with the North Atlantic *N. groenlandica*. The question can not be settled until more material is available for study. The genus *Bathymacrops* was proposed for this species in the original description. I follow Norman (1939) and Chapman (1948) in regarding *Bathymacrops* as a synonym of *Nansenia*.

I have examined a specimen of *N. macrolepis* (SU 31501) collected off Delagoa Bay, South Africa, and preserved in the Stanford Natural History Museum. D. 11, A. 11, pectoral 13, ventral 11, lateral line scale pockets 49, branchiostegals 3 (Gilchrist, 1922, reports 4 in the holotype), gill-rakers 11 + 1 + 20, standard length 130.7, predorsal 63.0, preanal 106.1, preventral 72.6, prepectoral 29.0, head length 27.4, snout 4.5, eye 11.0, depth at dorsal fin 16.2, width behind head 12.6, depth of caudal peduncle 8.8.

A crescent of white tissue similar to that found in *Argentina* and *Bathylagus* overlies the entire posterior half of the iris.

A single row of about 30, picket-like teeth is present on each dentary. The teeth are largest at the posterior end of the bone and become progressively smaller. Alternate teeth project slightly above their neighbors. The eight teeth (four on each dentary) at the symphysis of the lower jaw are uniform in size and as large as the most posterior dentary tooth. A single row of conical teeth is present in a continuous arc on the palatines and the head of the vomer. The tongue seems to lack teeth. Teeth are absent from the maxillary and the premaxillary.

The ventral fin inserts behind a vertical from the posterior of the dorsal fin base.

Nansenia ardesiaca Jordan and Thompson, 1914

Tanaka (1911) identified a *Nansenia* from the Sagami Sea as *N. grönlandica*. Jordan and Thompson (1914) obtained another specimen from Sagami Bay and proposed the name *N. ardesiaca* for their specimen and for Tanaka's *N. grönlandica*.

I have examined the holotype of *N. ardesiaca* (CNHM 57086) in the Chicago Natural History Museum. D. 10, A. 8, pectoral 12, ventral 11, lateral line scales 50, branchiostegals 2, standard length 164.5, predorsal 77.4, preanal 136.7, preventral 95.0, prepectoral 39.4, head length 36.6, snout 5.7, eye 15.5, body depth at dorsal fin 19.0, interorbital 9.7, depth of caudal peduncle 10.1, dorsal fin base 9.5, anal fin base 8.0.

Nansenia tanakai Schmidt, 1918

Chapman (1948) has discussed *N. tanakai* and its possible identity.

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AN ILLUSTRATION AND A NEW RECORD OF THE NORTH PACIFIC BATHYPELAGIC FISH MACROPINNA MICROSTOMA

By Margaret G. Bradbury and Daniel M. Cohen

The bizarre little deepsea fish *Micropinna microstoma* was originally described by Chapman (1939) from a series of specimens collected by the International Fisheries Commission in the northeastern Pacific Ocean. Localities ranged from 59° 21′ N., 143° 51′ W. in the North (south of Cape St. Elias, Alaska), to 53° 52′ N., 158° 29′ W. in the West (southwest of Kodiak Island), to a southerly locality of 51° 46′ N., 131° 37′ W. off the Queen Charlotte Islands, British Columbia.

More recently Rass (1955) has reported *M. microstoma* from the waters of the Kurile-Kamchatka Trench in the northwestern Pacific.

The present report is based on three examples captured off Monterey Bay,

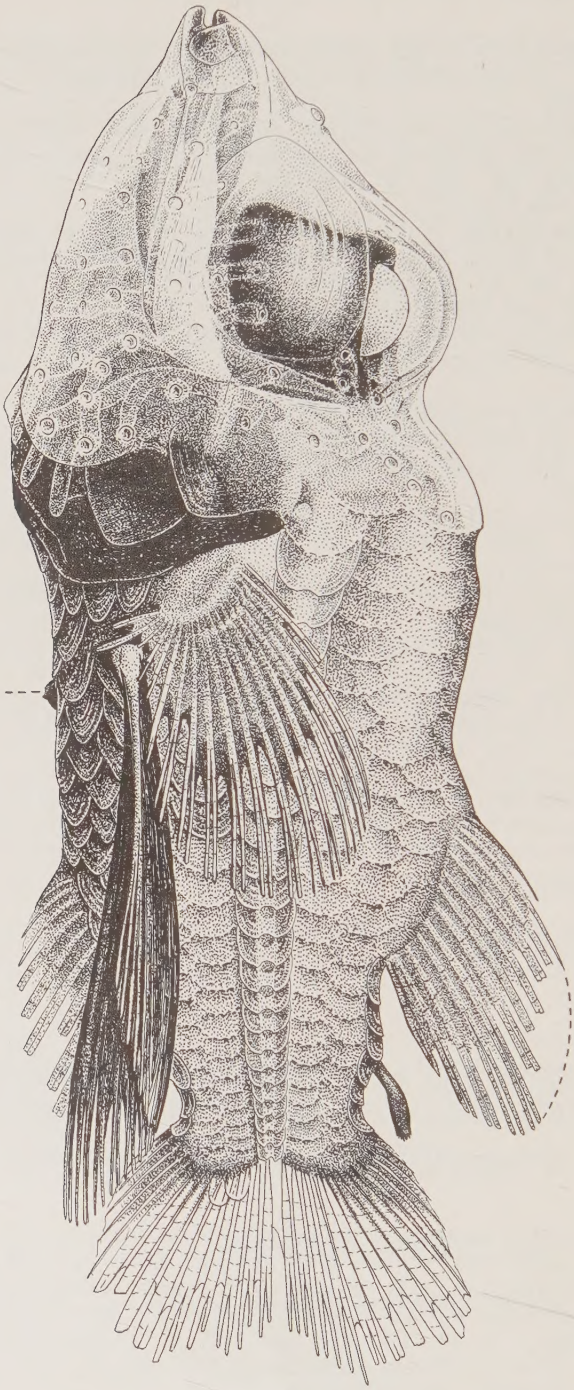

Fig. 1. *Macropinna microstoma*, SU 51027, "Tage" Station 537B. Standard length 40.7 mm.

California ("Tage" Stations 297B, 428B, and 537B) and constitutes a southern extension of the known range of the species of approximately 1800 miles.

Two of the specimens examined, SU 48780-48781, were larvae of 13.4 mm. and 16.1 mm. standard length. These specimens agree well with the descriptions and figures of larvae given by Chapman (1939) in having relatively more elongate bodies and snouts and in having the anus and ventral fins more posteriorly placed than do adults.

Counts and measurements are given below for the single adult (SU 51027, see Fig. 1, drawn by M.G.B.) which we have examined. Measurements are in mm. followed by percentage of standard length in parenthesis. D. 12; A. 14; pectoral 19; ventral 9?; branchiostegals 3; lateral line scales 23; standard length 40.7; preanal 31.6 (77.6); predorsal 28.5 (70.0); preventral 22.8 (56.0); prepectoral 18.9 (46.4); greatest body depth 14.1 (34.6); greatest body width 10.3 (25.3); least depth of caudal peduncle 6.0 (14.7); length of caudal peduncle 3.9 (9.6); dorsal fin base 6.9 (16.9); anal fin base 6.9 (16.9); vent to anal fin origin 7.0 (17.2); head 20.0 (49.1); greatest visible diameter of eye lens 4.5 (11.0); height of eye 8.2 (20.1); anterior edge of eye lens to tip of upper jaw 6.8 (16.7); interorbital 0.4 (1.1).

The proximal portions of some of the pectoral rays bear small patches of tissue which may be luminous; similar patches of tissue have been observed by one of us (D.M.C.) on the pectoral rays of specimens referable to the related genera *Rhynchohyalus* and *Opisthoproctus*. Scattered in the loose epidermis near the bases of the caudal fin rays are very small, sphere-shaped bits of tissue that also may possibly be luminous.

Macropinna microstoma is evidently a solitary-dwelling fish. Analysis of the catch data for the 28 specimens upon which Chapman (1939) based his description of this species shows that only two examples were taken in the same net. It is of interest to note that the three Monterey Bay examples were also taken in separate collections.

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